BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES**.

NAME: Arash Kheradvar, M.D., Ph.D., FAHA, FASE, FAIMBE

eRA COMMONS USER NAME (credential, e.g., agency login): ARASH00

POSITION TITLE: Professor of Biomedical Engineering and Medicine (cardiology)

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Tehran University of Medical Sciences, Tehran, Iran	M.D.	08/2000	Medicine
California Institute of Technology, Pasadena, CA, USA	Ph.D.	11/2006	Bioengineering
California Institute of Technology, Pasadena, CA, USA	Postdoctoral	10/2007	Cardiovascular Engineering

A. Personal Statement

I am a Professor of Biomedical Engineering and Medicine at the University of California, Irvine. My research focuses on cardiovascular science and engineering and capitalizes on my multidisciplinary background in bioengineering and medicine. The projects in my lab focus on a blend of fundamental and translational research.

Over my career, I have published over **75** peer-reviewed journal articles, am the lead inventor of **44** issued U.S. patents, mostly on heart valve systems, and cardiac imaging modalities and have authored **two** books: (1) *Vortex Formation in the Cardiovascular System* (ISBN: 9781447122883), published by Springer Cardiology; and (2) *Principles of Heart Valve Engineering* (ISBN: 9780128146613), published by Elsevier. The latter is the very first comprehensive reference book on heart valve engineering. My H-index is **40** and i10-index is **82**.

Here are the projects that I would like to highlight:

Ongoing

1 R01 HL157631, Griffith/Kheradvar/Fogelson, PIs **01/01/2022-12/31/2026**

Computational and Experimental Modeling of Subclinical Leaflet Thrombosis in Bioprosthetic Aortic Valves

1 R01 HL153724, Kheradvar, PI **01/01/2022-12/31/2027**

The state of energy in the right ventricle of patients with pulmonary arterial hypertension

1 R01 HL162687, Kheradvar, PI **01/01/2023-12/31/2028**

Reciprocal effects between scaffold geometry and ventricular vortex flow on viability and performance of tissue-engineered mitral valve

3 R01 HL153724, Kheradvar, PI **09/01/2023-08/31/2026**

Volumetric Echocardiographic Particle Image Velocimetry for Grading the Severity of Mitral Valve Regurgitation

1 R56HL173809, Yen/Kheradvar, mPIs **09/01/2024-08/31/2025**

High-speed 4D echocardiography system with adjustable multi-planar acquisition

National Science Foundation Award# 2109959, Kheradvar, PI **06/01/2021-05/31/2025**

Collaborative Research: Deciphering the synergistic interaction between hemodynamics and genetics that form the heart

Recently completed:

1 R21 HD105889, Kheradvar, PI **07/01/2021-06/30/2024**

A growth-accommodating transcatheter pulmonary valve system for young children

19AIML35180067, Kheradvar, PI **11/01/2019-10/31/2023**

Cloud-based AI platform for automatic segmentation and analysis of pediatric Cardiac MRI datasets

B. Positions and Honors

Positions and Employment

2017- Professor (tenured) of Biomedical Engineering, Mechanical & Aerospace Engineering, Computer Science, Electrical Engineering, and Medicine, UC Irvine
2013-17 Associate Professor (tenured) of Biomedical Engineering and Medicine, UC Irvine
2012-15 Honorary Research Fellow of Cardiac MR, Royal Brompton Hospital, London, UK
2011-13 Honorary Research Associate, California Institute of Technology, Pasadena, CA, USA
2011-13 Assistant Professor of Mechanical and Aerospace Engineering, University of California, Irvine
2010-13 Assistant Professor of Biomedical Engineering and Medicine, University of California, Irvine
2007-10 Assistant Professor of Mechanical Engineering, Internal Medicine and Cell Biology & Anatomy, University of South Carolina, Columbia, SC
2006-07 Postdoctoral Scholar, Cardiovascular and Biofluid Dynamics Laboratory, Caltech, Pasadena, CA
2002-06 Graduate Research Assistant, Cardiovascular and Biofluid Dynamics Lab, Caltech, Pasadena, CA
2000-02 Research Fellow, Immunogenetics Laboratory, Dept. of Immunology, Tehran University of Medical Sciences
1993-00 Medical Student, Tehran University of Medical Sciences, Tehran, IRAN Sciences, Tehran, IRAN

Other Experience and Professional Memberships

Editorial Board Memberships:

2017- Associate Editor, Annals of Biomedical Engineering
2022- Editorial Board Member, Journal of Cardiovascular Development
2004- Journal Reviewer (70+ journals): Science, PNAS, JCMR, JACC, JACC Basic to Translational Science, Proceedings of the Royal Society of London A, Lancet, JAHA, Scientific Reports, Circulation, Circulation Cardiovascular Imaging, Circulation Cardiovascular Intervention, Experimental Mechanics, JCTR, International Journal of Cardiovascular Imaging, Journal of Mechanics in Medicine and Biology, Journal of Fluid Mechanics, JMRI, Journal of Royal Society Interface, IEEE Transactions on Biomedical Engineering, IEEE Transactions of Medical Imaging, European Heart Journal Cardiovascular Imaging, Acta BioMaterialia, etc.
2005-13 ASAIO Journal

Study Sections:

2024 NIH CTIS Study Section (ad hoc member)
2023 NIH TDPS Study Section (ad hoc member)
2022- NIH Study Section Member 10 ZHL1 CSR-O (O2) 1, Catalyze: Product Definition
2021- NIH Study Section Member ZRG1 SBIB-D (02) M Member Conflict: Bioengineering, Surgery, Anesthesiology and Trauma
2021- NIH Study Section Member ZTR1 DPI-3 (01) UH2/UH3 applications for Intramural - Extramural Collaboration for Drug Screening with Biofabricated 3-D Disease Tissue Models
2019- NIH Study Section Member ZRG1 CVRS-Q 80: Cardiovascular and Respiratory Sciences NIH Research Enhancement Award Review
2009- American Heart Association's Radiology, Imaging and Surgery Committee
2007- National Science Foundation (NSF)
2016-17 NICHD 3D Printing Study Section (ZHD1 DSR-K(51))
2009-15 NIH Study Section Standing Member ZRG1 VH-D (50, 55) NHBLI System Biology.
2009-10 NIH Study Section Member ZRG1 SBIB-V (58) Challenge Grants Panel 23
2006 National Medical Research Council of Ministry of Health, Singapore

Founder and co-founder:

2018- ValVention, Inc.

2010-18 Folda, LLC
2010-13 WALVE, Inc.

Professional Memberships:
2023 Fellow, American Society of Echocardiography
2021 Fellow, American Institute for Medical and Biological Engineering (AIMBE)
2018- Member, Society for Cardiovascular Magnetic Resonance
2016 Fellow, Humboldt Foundation
2014- Member, American Society of Echocardiography
2013- Fellow, American Heart Association
2011- Member, European Mechanics Society
2011- Member, Society of Heart Valve Disease

Consultant:
2014-20 CalHealth, Inc.
2004- Edwards Lifesciences Corp.
2018-19 Cercacor, Inc.
2008-13 Ultrawave Labs, Inc.

Honors
2023 Fellow, American Society of Echocardiography
2021 Fellow, American Institute for Medical and Biological Engineering (AIMBE)
2020-22 Fulbright Distinguished Chair in Health Sciences by J. William Fulbright Foreign Scholarship Board
2019 UCI Beall Applied Innovation's inaugural Faculty Innovation Fellow
2016 Fellow, Alexander Humboldt Foundation (experienced researcher fellowship)
2015 American Heart Association Innovative Research Award
2014-20 Member, UCI's Samueli School of Engineering's executive committee
2014-16 Research Committee Member of the American Heart Association, Western States Affiliate.
2013- Fellow, American Heart Association; elected by two Councils on *Cardiovascular Radiology and Intervention* and *Cardiovascular Surgery and Anesthesia* of the American Heart Association.
2012-14 Honorary research fellow, Royal Brompton Hospital, London, UK
2012 Endorsed by *Royal Academy of Engineering* as an "exceptional promise" to be a world leader in Medical Devices and Medical Imaging areas of research.
2012 Transatlantic Career Development Award in Cardiovascular Research from Leducq Foundation
2009 Vivien Thomas Young Investigator Award Finalist nominated by American Heart Association
2002-06 Benjamin M Rosen graduate fellowship in Bioengineering/Engineering Science at Caltech

C. Contributions to Science *(selected from 2 books, over 75 peer-reviewed journal publications, 50+ patents/applications, and 125+ conference abstracts and 100+ invited talks)*

1. A significant focus in my laboratory is on the post-processing of cardiac MRI (CMR), with a particular emphasis on various aspects such as 4D Flow MRI, artificial intelligence for CMR segmentation, and flow reconstruction, especially in the context of congenital heart defects. Notably, one of our AI papers (Avendi et al., 2016) has gained substantial recognition, accumulating over 749 citations since its publication.

    a. Avendi MR, **Kheradvar A**, Jafarkhani H. A Combined Deep-Learning and Deformable-Model Approach to Fully Automatic Segmentation of the Left Ventricle in Cardiac MRI, *Medical Image Analysis,* 2016 Feb 6;30:108-119. PMID: 28205298
    b. Hajiaghayi M, Groves EM, Jafarkhani H, and **Kheradvar A**. A 3D Active Contour Method for Automated Segmentation of the Left Ventricle from Magnetic Resonance Images, *IEEE Transactions on Biomedical Engineering*, 2017 Jan; 64 (1): 134-144. PMID: 27046887
    c. Falahatpisheh A, Rickers C, Gabbert DD, Heng EL, Stalder A, Kramer HH, Kilner PJ, **Kheradvar A**. Simplified Bernoulli's method significantly underestimates pulmonary transvalvular pressure Drop. *Journal of Magnetic Resonance Imaging*, 2016;43:1313–1319. (Featured on the cover of the June 2016 issue). PMID: 26584006
    d. Karimi-Bidhendi A., Arafati A., Cheng A., Wu Y., **Kheradvar A.***, Jafarkhani H.* Fully-Automated Deep-Learning Segmentation of Pediatric Cardiac MRI of Patients with Complex Congenital Heart Diseases. *Journal of Cardiovascular Magnetic Resonance*, 2020 Nov 30;22(1):80. doi: 10.1186/s12968-020-00678-0. (*co-corresponding author). PMID: 33256762 PMCID: PMC7706241

2. My research also focuses on heart valve engineering, where my laboratory has successfully developed for distinct heart valves: (1) FoldaValve: A 14-French fully retrievable/repositionable valve designed to prevent stent crimping of leaflets; (2) Hybrid Tissue-Engineering Heart Valve (H-TEHV): A patient-specific tissue-engineered valve; (3) AValve: A transcatheter atrioventricular valve system, and (4) IRIS Valve, a growth accommodating transcatheter pulmonary valve system for very young children.

    a. Wang DD, Qian Z, Vukicevic M, Engelhardt S, **Kheradvar A**, Zhang C, Little SH, Verjans J, Comaniciu D, O'Neill WW, Vannan MA. 3D Printing, Computational Modeling and Artificial Intelligence for Structural Heart Disease. *Journal of American College of Cardiology: Cardiovascular Imaging*, 2020, Aug 25;S1936-878X(20)30515-5. PMID: 32861647
    b. **Kheradvar A**, Groves EM, and Tseng E. FOLDAVALVE: A Novel 14Fr Totally Repositionable and Retrievable Transcatheter Aortic Valve: Proof of Concept in Sheep. *Euro Interventions*, 2015 Mar 16;10(11) pii: 20141002-01. PMID: 25772904
    c. Alavi SH, Soriano Baliarda M, Bonessio N, Valdevit L, **Kheradvar A**. A Tri-leaflet Nitinol Mesh Scaffold for Engineering Heart Valves, *Annals of Biomedical Engineering,* 2017 Feb;45(2):413-426. PMID: 28008545
    d. Groves EM, Falahatpisheh A, Su JL, **Kheradvar A**. The Effects of Positioning of Transcatheter Aortic Valve on Fluid Dynamics of the Aortic Root, *ASAIO J.* 2014 Sep-Oct;60(5):545-52. PMID: 25010918 PMCID: PMC4334568

3. We pioneered quantitative characterization of transmitral vortex ring formation during diastole. In 2006, our groundbreaking paper, published in PNAS, introduced the vortex formation time index for diagnosing diastolic dysfunction. This work has been cited over 420 times to date, and the concept of the "vortex formation time index" has been successfully translated into cardiology clinics, now employed by cardiologists for diagnosing diastolic dysfunctions. Additionally, my research laboratory has played a crucial role in advancing Echocardiographic Particle Image Velocimetry (Echo-PIV) for mapping flow fields within heart chambers, and for vortex imaging. The journal article outlining Echo-PIV method (Kheradvar et al., JASE, 2010) has been cited 250 times, underscoring its impact on the field.

    a. **Kheradvar A**, Assadi R, Falahatpisheh, A, Sengupta, PP. Assessment of Transmitral Vortex Formation in Patients with Diastolic Dysfunction, *Journal of American Society of Echocardiography,* 2012, 25 (2) 220-7. (Featured on the cover of the February 2012 issue). PMID: 22099070
    b. **Kheradvar A**, Gharib M. Influence of ventricular pressure-drop on mitral annulus dynamics through the process of vortex ring formation, *Annals of Biomedical Engineering* 2007, 35 (12):2050-2064. PMID: 17899379
    c. Gharib M, Rambod E, **Kheradvar A**, Sahn DJ, Dabiri JO. Optimal vortex formation as an index of cardiac health. *Proceedings of National Academy of Sciences,* 2006, 103 (16): 6305-6308. PMID: 16606852
    d. Falahatpisheh A, Pahlevan NM, **Kheradvar A**. Effect of the Mitral Valve's Anterior Leaflet of on Axisymmetry of Transmitral Vortex Ring, *Annals of Biomedical Engineering*, 2015 Oct;43(10):2349-2360. PMID: 25821111

4. My research has made substantial contributions to various facets of cardiovascular solid and fluid biomechanics. Notably, we were the pioneers in characterizing the heart valves' collagen fiber orientation and their dynamics in response to load, utilizing second harmonic generation microscopy. Furthermore, we uncovered the adverse effects of stent crimping on the leaflets of transcatheter heart valves, as detailed in the publication by Alavi et al. in 2014, which has garnered 160 citations since its release.

    a. Zareian R, Tseng JC, Fraser R, Meganck J, Kilduff M, Sarraf M, Dvir D, **Kheradvar A**. Effect of Stent-Crimping on Calcification of Transcatheter Aortic Valves, *Interactive CardioVascular and Thoracic Surgery*, 2019 Jul 1;29(1):64-73. PMID: 30793744 PMCID: PMC6591709
    b. Alavi SH, Ruiz V, Krasieva T, Botvinick EL, and **Kheradvar A**. Characterizing the Collagen Fiber Orientation in Pericardial Leaflets under Mechanical Loading Conditions, *Annals of Biomedical Engineering*, 2013,41 (3) 547-561. PMID: 23180029 PMCID: PMC3963497
    c. Alavi SH, Groves EM, **Kheradvar A**. The Effects of Transcatheter Valve Crimping on Pericardial Leaflets, *The Annals of Thoracic Surgery*, 2014 Apr;97(4):1260-6. PMID: 24444873
    d. Barrett A, Brown JA, Smith MA, Woodward A, Vavalle JP, **Kheradvar A**, Griffith BE, Fogelson AL. A Model of Fluid-Structure and Biochemical Interactions for Applications to Subclinical Leaflet Thrombosis, *International Journal for Numerical Methods in Biomedical Engineering*; 2023 May;39(5):e3700. PMID: 37016277

5. My laboratory specializes in the development of medical devices to address structural heart diseases and software for advanced postprocessing of cardiac imaging modalities. From a portfolio of over 44 issued U.S. and 6 international patents.
    a. Falahatpisheh A and **Kheradvar A**. Ultrasound-based volumetric particle tracking method; U.S, patent# 9,962,142.
    b. Falahatpisheh A and **Kheradvar A**. Multi-plane method for three-dimensional particle image velocimetry; U.S. Patent# 10,345,132.
    c. Falahatpisheh A and **Kheradvar A.** Ultrasound-based volumetric particle tracking method; U.S. Patent# 10,460,452.
    d. Arafati A, Jafarkhani H, **Kheradvar A**. Fully automated four-chamber segmentation of echocardiograms; U.S. Patent# 11,651,487.

Complete List of my Published Work:
http://www.ncbi.nlm.nih.gov/pubmed/?term=kheradvar+a
https://scholar.google.com/citations?user=7MVET8kAAAAJ&hl=en